Solvothermal Synthesis and Photoluminescence of Y_2O_2S:Tb Nanophosphors

Glinka Yen and Teng-Ming Chen
Department of Applied Chemistry
National Chiao Tung University,
Hsinchu, Taiwan 30050
E-mail:tmchen@mail.nctu.edu.tw

Y_2O_2S:Tb has been known to be an X-ray phosphor used in practical X-ray intensifying screens and a green phosphor for CRT displays. Synthesis of Y_2O_2S:Er nanoparticles via flame spray pyrolysis and fluidized-bed sulfurization methods were reported by Bickmore et al.[1] and Niedbala et al.[2], respectively. However, there has not been any investigation on the synthesis and luminescence of Y_2O_2S:R (R = Eu, Tb) nanophosphors reported in literature.

In an attempt to investigate the quantum confinement effect on the luminescence and potential applications of Y_2O_2S:Tb nanophosphor, we have synthesized Y_2O_2S:Tb nanophosphors using a solvothermal route at 150 ℃ or lower in ethylene diamine or methanol solution. Interestingly, we have observed that the morphology of nano-Y_2O_2S:Tb synthesized from solvothermal reactions is strongly dependent of the solvents used.

The effect of synthetic temperature on the formation of Y_2S_2O:Tb nanoparticles were first investigated and the results are shown in Fig. 1. As- prepared nano-Y_2S_2O:Tb was found to be amorphous and decent crystallinity appears only when annealed at 500℃ under H_2S atmosphere, as indicated by the XRD profiles.

Shown in Fig. 2 is the TEM micrograph for nano-Y_2S_2O:Tb synthesized solvothermally from a solution of ethylene diamine at 150℃ and further annealed at 500℃ under H_2S for 6 hr. Nanorods of Y_2S_2O:Tb with high aspect ratio (diameter: 40 nm, length:1.6 μm) were observed. On the other hand, those prepared from methanolic solutions were found be nearly spherical with size of *ca.* 20 nm.

The quantum confinement effect on the luminescence intensity was clearly observed in PLE spectra shown in Fig. 3. A blue shift of 5 nm in the absorption band attributed to Tb^{3+} 4f→5d transition has been observed for nanocrystalline as compared to bulk Y_2S_2O:Tb. The observation has been rationalized by quantum size and surface effects.

The effect of surface capping on the luminescence intensity for Y_2O_2S:Tb has also been investigated by treating Y_2O_2S:Tb nanoparticles with allylamine (Ala) as a capping agent. We have discovered that well-crystalline bulk Y_2O_2S:Tb exhibits much stronger luminescence than Ala-capped nano-Y_2O_2S:Tb, whereas the pristine sample exhibits the weakest. We have demonstrated that the luminescence efficiency of nanophosphors can be effectively improved by surface capping.

References
1. C. R. Bickmore et al. *J. Europ.Ceram. Soc.* **18**, 287 (1988).
2. R. S. Niedbala et al. *Proc. SPIE* 3913, 1605 (2000).

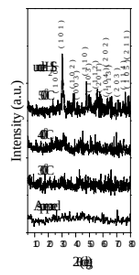

Fig. 1 XRD profiles showing the effect of annealing temperature on the formation of Y_2O_2S:Tb nanoparticles (as-prepared Y_2O_2S:Tb is poorly crystalline).

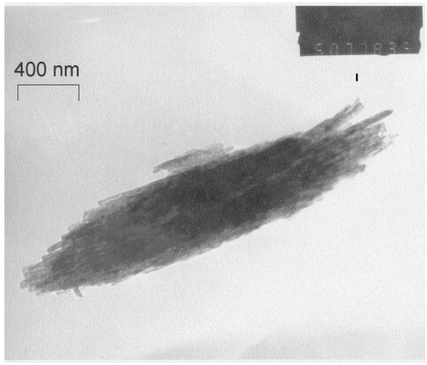

Fig. 2 The TEM micrograph for Y_2O_2S:Tb nanophosphor.

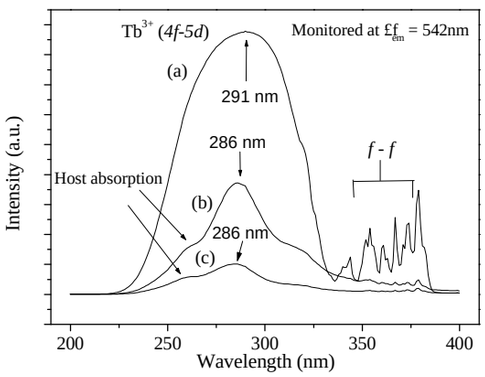

Fig. 3 Comparison of PLE spectra for (a) bulk, (b) Ala-capped- and (c) as-prepared Y_2O_2S:Tb.

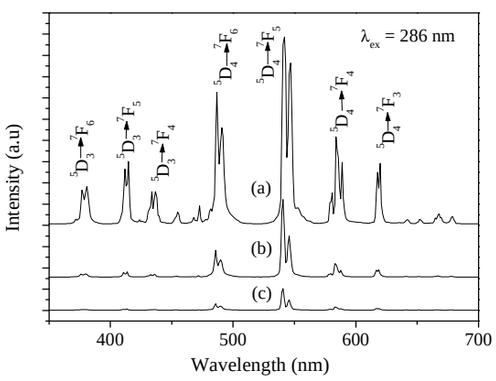

Fig. 4 Comparison of PL spectra for (a) bulk, (b) Ala-capped- and (c) pristine Y_2O_2S:Tb nanophosphor.

老師,這是 YOS 的圖

TEM	相對應 ED	相對應 scale
33	34	1cm=1/3um
35	36	1cm=1/5um
37	38	1cm=1/3um

實驗條件

1. 與學長條件只差在溶劑之不同,本實驗使用 en 爲溶劑,除此之外,另使用 allyamin 處理過.

2. 此 cpd 爲已經通硫化氫 500 度 6 小時 anneal 過的產物.

ps 因爲剛拿到照片,所以 ed 圖還沒 index

之後 index 後再給老師完整版